SOURCE OF HEALTH PROBLEMS IN CHILDHOOD: BIOLOGICAL ASPECTS*

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SOME would claim that the sources of the health problems children face today are basically biologic; others would argue that they are primarily socioeconomic in origin. However, thinking in terms of this dichotomy will not serve children well.

There are vitally important and often intimate relationships between medical and socioeconomic determinants of illness in children.[1,5] Recognition of these relationships and their incorporation into research designs and into prevention and care programs are fundamental to the possibility of achieving the goal of having every child realize his full potential as a productive happy adult.

The specific obstacles to achieving this goal have changed dramatically over the past 100 years. The leading causes of childhood mortality and morbidity at the onset of the 20th century included dysentery, pneumonia, measles, tuberculosis, diphtheria, whooping cough, malnutrition, rheumatic fever, and the like. The major causes of death and disability as we enter the 21st century include congenital malformations, low birthweight and its closely related constellation of disorders, sudden infant death syndrome, malignancies, accidents, homicides, suicides, and child abuse. A common denominator to the contrasting patterns of health problems at the beginning and end of this century is that at the source of many of the problems there continues to be a complex interaction between the biologic and environmental determinants of illness in childhood. We must direct our strategies at this interaction if we are to make progress against many of the illnesses of childhood.

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For example, the decrease in infant deaths from diarrhea earlier in this century in the United States was due to improvements in sanitation and milk processing, developments in the science and technology of bacteriology, advances in infant nutrition, and improved medical management of fluids and electrolyte treatment of dehydration. Similarily, today the death and disability rates from accidents can be decreased by a combination of lower speed limits, community volunteer programs directed specifically against drinking and driving, seat belt and motorcycle helmet laws, regional emergency transport systems, intensive care, and new methods of rehabilitation.

In recent years there has been a tremendous increase in knowledge and applications of science and technology. I shall focus on what has been happening in regard to our basic understanding of human biology as it relates to disease.

Biomedical science can be characterized as moving in two general directions, reductive or resolving problems by reducing them to most basic level, and integrative. First, in the reductive mode we have moved from describing and understanding biologic mechanisms at the level of gross and histologic pathology, to the level of organ system dysfunction in physiologic and biochemical terms, to the level of cellular and then intracellular abnormalities, and now to the level of the molecular and genetic basis of disease. In the integrative mode we have been increasing our understanding of the complex interactions among genes, cells, and organ systems; the relationship between psychologic and physical responses to disease processes and illness and the impact of the social milieu on these responses; the biochemical and molecular correlates of complex abnormal human behaviors; and the relationships between the epidemiology of disease, biologic markers, and the demography and dynamics of population groups. These scientific advances, especially the advances in understanding the integration of life processes, hold forth great promise for more effective strategies to deal with problems as diverse as suicide, congenital malformations, and low birthweight.

Unfortunately, some physicians and biological scientists, in their excitement and enthusiasm arising from the giant steps forward that have been made in understanding human biology and disease, have lost sight of the critical importance of environmental determinants in the way illness becomes manifest in children or have become frustrated with the difficulties in changing the social and economic environment in a fashion that will benefit children. Alternatively, some social and political advocates for children and social scientists have undervalued the role of biologic determinants as science

and technology have become more difficult for nonexperts to understand. The myth of purely social and political solutions for complex human problems is seductive, but simplistic.

Low birthweight births are a premier example of the interweaving of medical and socioeconomic determinants that occur in many of the health problems of children. The potential benefits of applying reductive and integrative science to this problem are great, but have so far been largely neglected.

First, it is important to appreciate that we focus on infants of low birthweight because we want to reduce significantly neonatal and infant deaths and functional disabilities in surviving infants. Over the past decade alone, mortality of infants weighing 1,500 to 1,000 grams has fallen from more than 50% to about 10%, and mortality for those weighing less than 1,000 grams has fallen from around 90% to about 50%.[7,9,10,13]

The low birthweight problem should also be kept in perspective. A number of deaths occur in normal weight infants, especially in association with poverty,[1,5,14] and related to congenital malformations, sudden infant death syndrome, and infections. Many of the adverse social and demographic variables associated with increased rates of low birthweights are also more generally associated with mortality and morbidity later in childhood.[1,5,14]

Approximately 75% of infants who die during the postneonatal period are of normal birthweight.[3] It has been estimated that only about a quarter of postneonatal deaths are not preventable; nearly a third are clearly preventable. Access to care plays an important role in postneonatal deaths since many do not occur in the hospital, and the total and cause-specific postneonatal mortality rates for blacks are significantly higher, two or three fold, than for whites.[2,8,12] The risk of death is greater for rural infants for whom the racial differential is also increased.[3]

Infectious diseases contribute about 12.5% of all infant deaths, about 9% of deaths of low birthweight infants, and more than 18% of all deaths during the neonatal period. For black infants, the mortality rate related to infectious diseases is more than twice that for white infants.[6]

The sudden infant death syndrome (SIDS) accounts for more than 12% of all infant deaths. Ten to 30% of deaths of infants discharged home after receiving neonatal intensive care units have been attributed to SIDS.[10,13] There are still significant reporting problems in regard to making the diagnosis of SIDS because of our continuing ignorance about the balance of biologic and environmental factors important to its occurrence. At present, except in the case of siblings of children who have died of SIDS and instances

of infants who have had a significant life-threatening event themselves, we have no reliable medical or epidemiologic basis on which to predict which infants are at risk for SIDS.

Child abuse and neglect cause 1 to 3% of infants' deaths. The complex societal, economic, and behavioral determinants of this problem are in some instances closely related to those of illness associated with low birthweight infants, but in many cases these determinants represent a unique constellation of psychosocial factors.

Very different medical and social strategies need to be developed and implemented to deal with each of these problems, but economic impediments to care are a recurrent theme.

Low birthweight infants, those weighing less than 2,500 grams, are a heterogeneous mix of preterm or premature and intrauterine growth retarded children. The provision of neonatal intensive care has markedly improved their survival without a significant increase in the rates of severe morbidity. However, as the number of surviving healthy infants weighing less than 1,500 grams has increased, the number of infants with significant functional impairment has also increased. The birth rate of these very low birthweight infants, many of whom are born after a preterm labor, has not decreased substantially. The relative importance of neonatal intensive care is underscored by the fact the low birthweight rate declined only 14% since 1970 compared to a 50% decline in infant mortality which was due, in large part, to reductions in birthweight specific mortality of low birthweight infants who received intensive care.

A variety of scientific and technologic advances laid the foundation for effective neonatal care, more than half of whose recipients are normal weight infants.[10] Regionalization has played an important role, now being undermined by the commercial model for health care which has led to a competition for insured patients. Further, the success of neonatal intensive care has raised a number of serious ethical and economic questions which, unfortunately, have not always been responsibly addressed by physicians, social scientists, and political leaders. New technology such as extracorporeal membrane oxygenation is making these issues even more important and urgent.

The need for means to prevent the birth of infants before they have attained a normal birth weight is clear. A great variety of medical, psychosocial, economic, behavioral, and demographic factors have been associated with the frequency of birth of very low birthweight infants. These factors vary widely in their causal relationship. However, even when we account for

specific causes such as hypertension of pregnancy, diabetes, multiple pregnancies, intrauterine fetal infections, and so forth, there are still a significant number of pregnancies with this outcome for which we need additional preventive strategies.

Although earlier prenatal care and more adequate prenatal care are generally associated with a lower birthweight rate and substantial cost savings compared to neonatal intensive care, why and how this occurs, what components of care are critical, are unknown. Moreover, a variety of prospective medical and psychosocial intervention studies have failed so far to lower the birthweight rate. I base this judgement on my assessment of reports presented earlier this month at an international conference on intervention studies to prevent low birthweight sponsored by the Bureau of Maternal and Child Health and the National Institute of Child Health and Human Disease. Our understanding of the epidemiology of this problem in populations at various degrees of risk is not sufficient adequately to predict the risk for an individual pregnant woman and to design appropriate interventions. It is simply not good enough for developing rational intervention strategies for us to be able to identify statistical associations with black race, single parents, low education and economic status, previous birth of a low birthweight infant, poor access to care, stressful life style, and so forth.

Similarly, although there is an understanding of the pattern of hormonal and related chemical changes in the blood and uterine contractions that occur during normal labor, our biologic understanding is not yet adequate to deal with the problem of preterm labor and intrauterine growth retardation. We do not understand enough about the vulnerability of the uterus to adverse internal and environmental stimuli before and during preterm labor at a cellular, gene, and molecular level rationally to relate the biology to the everyday world of the women and fetuses at risk.

Given the biologic and societal anatomy of this problem as we know it now, it seems to me that we should proceed with at least two strategies that will provide a foundation for making some headway with this problem.

First, we need to meld the approaches of reductive and integrative science with a refinement of our knowledge about the most relevant environment factors associated with the birth of low birthweight infants. These are frequently related to poverty.[2,8,14] This will necessitate multidisciplinary studies by biologic and social scientists. For example, studies should be designed simultaneously to characterize patterns of preterm prelabor uterine contractures and biochemical changes and patterns of work-related stress and coping behavior. This should be done in subsets of women who appear to be

at similar environmental risk but have different outcomes and those who appear to be at different environmental risk but have similar outcomes as far as low birthweight is concerned. The methodology, technology, and science for such studies are available and can help us to evolve rational intervention strategies that can then be tested.

Second, because economic deprivation is an inseparable part of many of the environmental determinants, we need to provide a reimbursement system that will assure that the access to care of pregnant women and children is not obstructed by their inability to pay for it. Such an insurance system could be phased in by increments of birth cohorts over time until all children are covered. This would be a manageable way to move forward without a sudden economic burden. This system should be paid for by a combination of public funds and employee and employer payroll taxes since the future economic productivity and international competitiveness of this country is tied irrevocably to the health of these children. Whatever medical interventions prove effective will need to be adequately financed if they are to be made available to those who need them.

In conclusion, this is the best of times and worst of times. The low birthweight problem, which is illustrative of many of the health problems of children as we approach the end of the century, is particularly difficult because its origins lie in a complex interaction of biologic and environmental variables. However, we are also fortunate to have the scientific and political tools at hand with which to address such problems if we are wise enough to use them well and if our children become our first priority.

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